Space Weather Technical Forecast

Issued on Thursday, 27 April 2023 at 01:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1-G2/Minor-Moderate Storm risk Day 1 (27 Apr) but reducing. Slight chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout. Chance of Active fluence throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with only a small number of minor C-class flares observed. There are currently seven sunspot regions on the visible disc. AR3285 and AR3288 in the southeast quadrant are currently the two largest regions on the disc, both continue to show minor development and reasonable complexity. AR3289 near the northeastern limb may prove to be a complex region, but is too near the limb for a complete view or a proper classification. All other remaining sunspot regions are small at present.

A filament eruption from the southwest quadrant beginning around 25/1900 UTC has led to a CME which is mostly directed south and west of Earth. There is a very low chance of a glancing blow during the 28 April. A further filament eruption around 26/0545 UTC, also from the southwest, appears directed slightly further away from Earth although a very slight glancing blow remains possible, most likely during the 29 April.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE/DSCOVR at L1, has shown persistent elevated wind speeds during much of the period around 500-550km/s, with a slow increase from around 26/1800 UTC up to strong levels of 600-650km/s likely due to High Speed Stream (HSS) influence. The density has been fairly steady at average or just above average levels, becoming more variable from around 26/2000 UTC. The IMF (Bt) was weak at 6 nT or below, with an increase recorded at approximately 26/1730 UTC to a peak of around 10nT before slowly declining back to around 7-8nT by the end of the period. The north-south component (Bz) has been mostly weakly southward directed but highly variable, generally between +/-5 nT but with peak values of -8nT and +9nT recorded shortly after the increase in Bt. The phi angle was predominately negative (towards the Sun) at. Geomagnetic activity has been Quiet to Active (Kp 1-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, has been at background levels throughout. High energy electron flux (greater than 2MeV) as measured at GOES16, has been at background to moderate levels. The associated 24-hour electron fluence was below the Active threshold on a steady trend through the first half of the period, but rose rapidly during the second to record 1.07e8 integrated pfu at 26/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low, with just a slight chance of reaching Moderate levels.

Solar Wind / Geomagnetic Activity: A filament eruption on 24 April produced a CME which

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may give a glancing blow at Earth in the first half of Day 1 (27 Apr). Further filament eruptions on 25-26 April gave CMEs which is considered most likely to miss, but there is a very low risk of a glancing blows during Days 2 and 3 (28 and 29 Apr).

Solar wind speeds currently at elevated levels with the likely arrival of the HSS associated with equatorial CH96/-. The potential arrival of the CME from 24 April could combine with the HSS to increase the geomagnetic response. The HSS from CH96/- is expected to continue at affect Earth into Days 2 and 3 (28 and 29 Apr), perhaps with some weakening of the winds during Day 4.

Geomagnetic activity is expected to be Unsettled or Active with a chance of G1/Minor Storm conditions and a slight chance of a G2/Moderate Storm (Kp 6) during Day 1, given the potential for CME arrival. Activity is then likely to generally wane through Days 2, 3 and 4, although the risk of further CME glancing blows on Day 2 and 3 prolong a slight chance of G1 intervals.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is most likely to continue at background levels. High energy (greater than 2MeV) electron flux is currently at moderate levels, but is expected to remain more generally suppressed through Days 1 and 2 (27-28 Apr) with the possibility of minor geomagnetic activity from combined CME and HSS effects. As HSS effects start to ease through Day 3 and 4 (29-30 Apr) a rise is then probable. The associated 24-hour integrated fluence is expected to show a generally declining trend on Day 1, but with a chance of Active (1e8 integrated pfu) levels to start, followed by generally more suppressed activity through Days 2 and 3 (28-29 Apr). A chance of Active levels continues throughout however.

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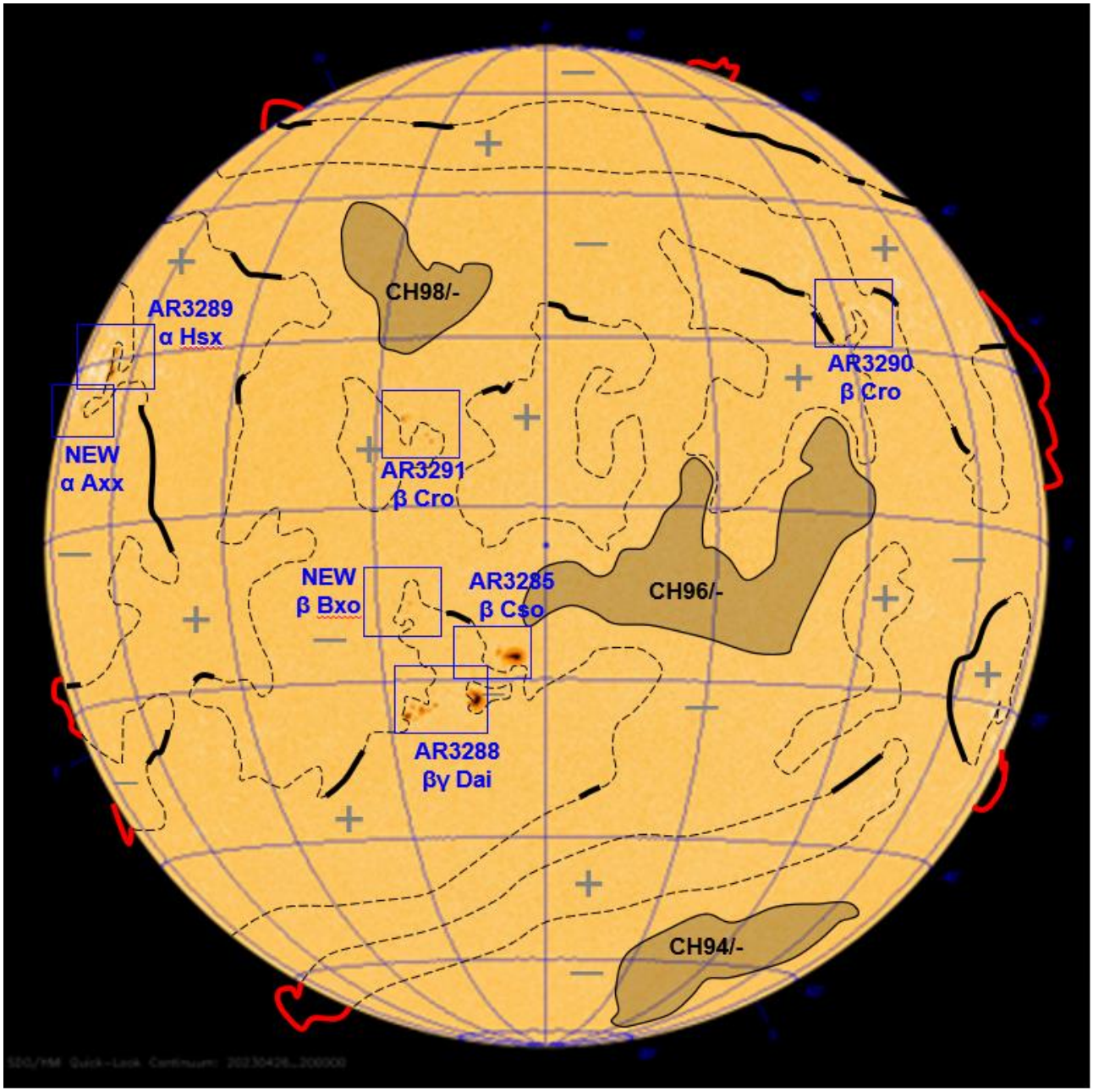
Figure 1. Solar Analysis Valid 26/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption occurred near south center disc starting around 24/1300 UTC. The CME was observed in coronagraph imagery heading generally south, but some Earth directed component is probable, with this most likely glancing Earth sometime during the first half of Day 1 (27 Apr). Arrival time estimates through ensemble forecasting vary however indicating there is some uncertainty over the timing of this feature passing by Earth.

Two further filament eruptions from the southwest quadrant were observed to produces CMEs late of the 25 and early on the 26. These appear mostly directed ahead of and below Earth's orbit, and are considered most likely to miss, but there is a very low risk of glancing blows during Days 2 and 3 (28-29 Apr).

Solar wind speeds currently at elevated levels with the likely arrival of the HSS associated with equatorial CH96/-. Current observed speeds of around 550-600 km/s are consistent with this feature on the previous rotation, with an upper estimate of strong winds in the region of 650-700km/s possible into Day 1 (27 Apr). The potential arrival of the CME from 24 April could combine with the HSS to increase the geomagnetic response. The HSS from CH96/- is expected to continue at affect Earth into Days 2 and 3 (28 and 29 Apr), perhaps with some weakening of the winds during Day 4.

Geomagnetic activity is expected to be Unsettled or Active with a chance of G1/Minor Storm conditions and a slight chance of a G2/Moderate Storm (Kp 6) during Day 1, given the potential for CME arrival. Activity is then likely to generally wane through Days 2, 3 and 4, although the risk of further CME glancing blows on Day 2 and 3 prolong a slight chance of G1 intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	20	10	5
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
24/1900	Partial	Filament Eruption	SW	700 km/s	27/0300 UTC	Glancing blow likely

Figure 2: Latest ENLIL ensemble output showing potential CME glancing impacts on the 27th, 28th and 29th with reducing certainty. Also displays the general HSS influence during the period.

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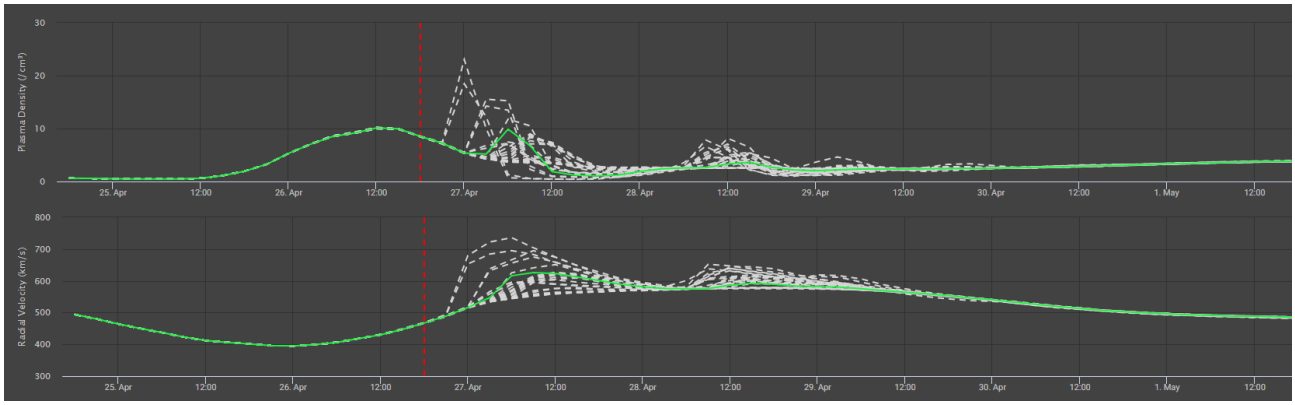

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Radio Blackouts - X-Ray Flares:
There are currently seven sunspot regions on the visible disc. AR3289 near the northeastern limb looks to be reasonably large but uni-polarity with no obvious trailing spots at present, however it remains too near the limb for a clear view. The classification is likely to change as it moves into a better viewing position in the coming days. The two largest regions on the visible disk, AR3285 and AR3288 in the southeast quadrant, continue to show minor development and reasonable complexity, with AR3288 (Dai, Beta-Gamma) providing the bulk of current flare risk. AR3290 in the northwest (now Cro/Beta) has waxed and waned, fading slightly in recent hours. Conversely AR3291 (now Cro/Beta) in the northeast has developed in recent hours. An apparently separate spot to the south of AR3289 and one other new sunspot region to the north of AR3285 remain small and simple at present.

Far side imagery indicates further active regions could rotate across the northeastern limb during the period. However, until such regions emerge, any increase in flare risk cannot be accurately assessed. Overall solar activity is expected to remain Low, but with a slight chance of Moderate activity given the potential for isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	15	15
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV) is currently at background levels. There is just a very slightly increasing risk of reaching the S1/Minor Storm level or greater during the period as the current largest active regions rotate westwards.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	2	3	4
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):
High energy (greater than 2MeV) electron flux is currently at predominantly moderate levels. The BAS radiation belt model suggests that electron density has increased in the radiation belt due to recent CME influence. However, elevated wind speeds with the recent arrival of the HSS associated with CH96 mean that the radiation belt may become compressed with electron flux levels suppressed at GEO. Flux levels expected to remain generally suppressed through Days 1 and 2 (27-28 Apr) with the possibility of minor geomagnetic activity from combined CME and HSS effects. As HSS effects start to ease through Day 3 and 4 (29-30 Apr) a rise is then probable.

The associated 24-hour integrated fluence is expected to show a generally declining trend on Day 1, but with a chance of Active (1e8 integrated pfu) levels to start, followed by more suppressed activity through Days 2 and 3 (28-29 Apr). An increase may occur on Day 4 (29-30 Apr) following the expected easing of geomagnetic activity, but with low confidence. MOSWOC REFM model is currently providing somewhat poor guidance, most likely due to recent CME influence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	50	30	30	40
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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